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EPIZOOLOGICAL SURVEY OF CERTAIN ENDEMIC DISEASES IN THE SOUTHERN PART OF THE GREAT SALT LAKE DESERT.

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5 September [redacted] 1957 - Dec[redacted] 1958.

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RESIDENT DIRECTOR

AND

STAFF

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Ecological Research, University of Utah

*Supported by U. S. Army Chemical Corps Contract No. DA-42-[redacted]-CML-355 with the University of Utah

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TABLE OF CONTENTS

INTRODUCTION

This report contains the results of a survey of certain diseases in native animals and domestic cattle during the period from September 4, 1957 to December 31, 1958.[1] The majority of the specimens were collected on Dugway Proving Ground and adjacent areas in Tooele and Juab Counties. The tissues of wildlife specimens were examined for plague, Pasteurella pestis; tularemia, P. tularensis; anthrax, Bacillus anthracis; brucellosis, Brucella species; Rocky Mountain spotted fever, Rickettsia rickettsii; Q fever, Coxiella burneti; and psittacosis. The wildlife and cattle sera were tested for complement-fixing antibodies for Q fever, Rocky Mountain spotted fever and the psittacosis-Lymphogranuloma group; and agglutinating antibodies for tularemia and brucellosis.

During the first part of this report period the laboratory building was being remodeled to insure safety in handling pathogenic organisms. The remodeling was sufficiently advanced to begin laboratory work by March, 1958. This report contains the results obtained from guinea pig injection of the tissues from 3,085 native animal carcasses and 211 ectoparasite pools, and the serological examination of 1,364 native animal and 176 domestic cattle sera.

METHODS

The methods used are essentially the same as those described by Rocky Mountain Laboratory in the annual reports of Dr. H. G. Stoenner to Chief, E and E Branch, BW Operations Division, Dugway Proving Ground, Dugway, Utah, dated 17 May, 1955 to 20 July, 1956. One modification of previous methods was the use of commercial antigens, since the antigens used by the prior contractor were

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[1] Supported by U. S. Army Chemical Corps Contract No. 42-007-403-CML-355, with the University of Utah.

not available in the quantities needed. The following strains of antigen were obtained from Lederle Laboratories: (1) Q fever, American (Nine Mile)strain, (2) Rocky Mountain spotted fever, (3) psittacosis, (4) Febrile Br. abortus, and (5) P. tularensis. Another modification was to postpone the isolation of C. burneti and R. rickettsii in eggs, and limit their detection to infection of guinea pigs, as indicated by the development of complement-fixing antibodies until facilities could be completed to perform this work in the laboratory. Agglutinating titers were considered positive at 1/40, while complement-fixing titers were considered positive at 1/16.

RESULTS

Tables: The results of these studies are summarized in Tables 1, 2, 3, 4, 5 and 6. Table 1 shows the pathogenic organisms in tissues of native animals by species, as determined by their production of complement-fixing and agglutinating antibodies after parenteral injection of the animal tissues into guinea pigs. Table 2 presents the same results by areas. Table 3 shows the complement-fixing and agglutinating antibodies found in the sera of these animals by species, while Table 4 shows the same results tabulated according to the areas from which the samples were obtained. Table 5 summarizes the serological indications of the pathogenic organisms (as determined by guinea pig injection) from pools of fleas, mites, ticks and lice obtained from the native animals recorded in Table 1. The serological results of cattle sera tested are tabulated in Table 6.

Q fever: Twelve pools of tissues from 5 species of native animals collected from 8 trapping areas produced complement-fixing antibodies in guinea pigs after injection. Six of these original pools were retested and 5 of the pools produced similar antibodies in the second set of guinea pigs. During both tests the sera of control guinea pigs housed in the same room were negative. The

species of animals showing evidence of this organism are shown in Table 1, and the location from which these positive animals were trapped is shown in Table 2. Serum samples from 64 native animals of 11 species collected from 16 trapping areas had complement-fixing antibody titers of 1/16 or greater, Tables 3 and 4. The presence of viable C. burneti was not indicated in any of the ectoparasite pools tested.

Rocky Mountain spotted fever: Guinea pigs injected with tissues from 30 animal pools of 7 species trapped in 10 areas, produced complement-fixing antibody titers. Titers were also found in guinea pigs injected with 5 pools of fleas, 2 pools of mites, 9 pools of lice, and 14 pools of ticks. The species of animals showing evidence of R. rickettsii in these tissues are shown in Table 1, and the incidence by areas is shown in Table 2. The types of ectoparasite pools producing complement-fixing antibody titers in guinea pigs are shown in Table 5, along with the area from which these ectoparasites were collected. Complement-fixing antibodies against R. rickettsii were also found in 113 native animals of 12 species collected from 16 trapping areas, as recorded in Tables 3 and 4. Serological evidence of RMSF was also found in 3 of 176 cattle serum samples tested, Table 6.

Psittacosis: As determined by guinea pig infection, organisms were indicated in the tissues of 5 native animals consisting of 4 species, collected from 4 trapping areas, Tables 1 and 2. Complement-fixing antibody titers occurred in 24 sera of 7 species collected from 11 trapping areas, Tables 3 and 4. During the course of the investigation, serological tests were discontinued at the request of the Project Officer.

Brucellosis: No isolations of Brucella species were made during this report period, nor were there any agglutinations at 1:40 or higher. Some

difficulty was experienced in standardizing the serological tests, consequently there may have been some false negatives.

Tularemia: No serologically positive sera were found during the report period. P. tularensis was, however, isolated from a pool of 2 jack rabbits obtained from an epizootic area in North Skull Valley.

Anthrax: No evidence of B. anthracis was found during this report period, using standard culture methods.

Plague: No evidence of P. pestis was found during this report period, using standard culture methods.

DISCUSSION

Q fever: Since the serological evidence of C. burneti in inoculated guinea pigs and in the sera of the native animals is considerably greater in the current period than in any previous year, some explanation is needed to understand the probable epizoology of this disease over the past 5 years.

Although the sampling area has remained relatively constant since 1954, with the exception of the addition of sampling stations near Wendover, Utah, the distribution of Q fever positives as indicated by complement-fixing titers of 1:16 or higher has greatly increased since the first sero-positive jack rabbit was found 2 miles east of Simpson Buttes in the winter of 1954.[2] The following year another sero-positive rabbit was found in the same area and the organism was isolated from a pool of ticks, Dermacentor parumapertus Neumann, taken from

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[2] All specimens were collected by the U of U Ecological Research, Dugway, Utah. Diagnostic services were performed by the Rocky Mountain Laboratory, Hamilton, Montana, prior to August, 1957, and by the U of U Epizoology Laboratory since that time.

rabbits in this same area. During the same summer (1955) the organism was isolated from a pool of tissues of deer mice, Peromyscus maniculatus, captured 7 miles northwest of this focus and from a pool of ticks, D. parumapertus, taken from rabbits captured 23 miles to the northwest, just north of Wig Mountain.

By the spring of 1957 the incidence of the disease in wildlife had increased sharply, exhibiting 30% infection in rodents of 3 collection stations, all within 23 miles of the area of the first sero-positive rabbit. At this time the total area from which positive specimens were taken comprised approximately 160 square miles, all within the fenced boundaries of Dugway Proving Ground. During the fall of 1957 the first positive wildlife specimen was obtained outside of Dugway Proving Ground when C. burneti was found in a pool of tissues from 2 rabbits collected 53 miles west of the original focus.

During 1958 serological positives were found as far west as Callao, the Deep Creek Mountains, and in areas near Wendover. The eastern distribution of specimens yielding serological evidence of Q fever included Skull Valley and St. John. The latter area was not sampled regularly prior to 1958, although wildlife specimens have been taken periodically in this area since 1954. Excluding the Wendover area, the distribution of the positive samples in 1958 comprised an area in excess of 3,000 square miles, compared to a distribution of approximately 160 square miles in the spring of 1957.

There are two probable explanations of this increase in incidence and distribution of Q fever; the first being that this disease was enzootic during 1953, 1954 and 1956, and did not reach epizootic proportions until 1957 and 1958. Supporting this premise that Q fever is enzootic in the wild life of the

United States is an epizoological survey in Texas[8] in which some serological positives were reported in wood rats, Neotoma micropus. Certainly there is no reason not to expect the disease in native animals of the United States, since Q fever has been reported in wildlife throughout many other areas of the world.[4] In fact, Perez, et al., suggests that wild mice and rabbits are reservoirs of Q fever in Spain.[5]

The second explanation being that the disease became established in the study area sometime prior to 1954 and spread rather rapidly in a susceptible wildlife population. This latter premise is supported by the fact that prior to 1955 only one specimen was sero-positive for Q fever, but after this time the incidence and distribution of the disease have greatly increased, indicating spread from a local focus. This theory is further corroborated by the apparent absence of Q fever from other wildlife disease surveys made in the western areas of the United States, particularly the large number of specimens processed by Rocky Mountain Laboratory prior to 1954.

Since neither of these premises can be completely validated in the light of the present data, further studies on the distribution and isolation of this organism should be pursued not only in the present study area and the immediately adjacent areas, but also in areas beyond this area of infection far enough to reach outside the current focus. Certainly these distant control areas would be the most logical approach to properly evaluate the foregoing question and would

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[3]Irons, J. V., R. B. Eads, C. W. Johnson, O. L. Walker, and M. A. Norris, 1952. Southwest Texas Q fever studies. Jour. of Parasit. 38:1-5.

[4]Stoker, M. G. P., and B. P. Marmion. 1955. The spread of Q fever from animals to man. Bull. World Hlth. Org. 13:781-806.

[5]Perez Gallardo, F., G. Clavero, and S. Hernandez. 1952. Epidemiological studies of Q fever in Spain. Rev. Sanidad. Hig. Publica Madrid. 27:81-97.

add appreciably to the meaning of the data. Such a study should not be delayed because of the possible rapid spread of this organism in wildlife.

Rocky Mountain spotted fever: The frequency of sero-positive reactions and isolations from many speices of mammals of RMSF indicates a widespread, continuous enzootic condition in wildlife.

Tularemia: The conspicuous absence of serological titers for P.tularensis from rodents in the areas where tularemia is enzootic and where it is occasionally isolated from rabbit tissues and ectoparasites, suggests that native rodents do not survive when infected with the local strains of this organism.

TABLE 1

Incidence of viable disease organisms*, by species, in 23 species of native animals as indicated by antibody titers in guinea pigs 42 days after parenteral injection of the animal tissues. (-) indicates a negative response.

Species	Number tested	Q fever		RMSF		Pistt.		Tul.	
		No.	%	No.	%	No.	%	No.	%
Lepus californicus									
Black-tailed jack rabbit	228	2	0.9	1	0.4	-	-	1**	0.4
Sylvilagus nuttallii									
Nuttall cottontail	1	-	-	-	-	-	-	-	-
S. audubonii									
Audubon cottontail	7	-	-	-	-	-	-	-	-
Citellus leucurus									
Antelope ground squirrel	212	1	0.5	2	0.9	1	0.5	-	-
Eutamias minimus									
Least chipmunk	44	-	-	-	-	-	-	-	-
E. dorsalis									
Cliff chipmunk	14	-	-	-	-	-	-	-	-
Thomomys bottae									
Pocket gopher	1	-	-	-	-	-	-	-	-
Perognathus longimembris									
Little pocket mouse	88	-	-	-	-	-	-	-	-
P. parvus									
Great Basin pocket mouse	117	-	-	-	-	-	-	-	-
P. formosus									
Long-tailed pocket mouse	71	-	-	-	-	-	-	-	-
Microdipodops megacephalus									
Kangaroo mouse	15	-	-	-	-	-	-	-	-
Dipodomys ordii									
Ord kangaroo rat	607	3	0.5	8	1.3	1	0.2	-	-
D. microps									
Chisel-tooth kangaroo rat	683	3	0.4	7	1.0	-	-	-	-
Reithrodontomys megalotis									
Harvest mouse	60	-	-	-	-	-	-	-	-
Peromyscus crinitus									
Canyon mouse	42	-	-	-	-	-	-	-	-
P. maniculatus									
Deer mouse	752	-	-	8	1.1	2	0.3	-	-
P. truei									
Pinyon mouse	27	-	-	-	-	-	-	-	-
Onychomys leucogaster									
Grasshopper mouse	10	-	-	-	-	-	-	-	-
Neotoma lepida									
Desert wood rat	98	3	3.1	3	3.1	1	1.0	-	-
N. cinerea									
Bushy-tailed wood rat	1	-	-	-	-	-	-	-	-
Erethizon dorsatum									
Western porcupine	3	-	-	-	-	-	-	-	-
Vulpes macrotis									
Kit fox	2	-	-	-	-	-	-	-	-
Spilogale gracilis									
Spotted skunk	2	-	-	1	50.0	-	-	-	-
Total	3,085	12	0.39	30	0.97	5	0.17	1	0.03

* Tests were negative for plague, anthrax and Brucella.

** P. tularensis isolated from tissues of injected guinea pigs.

TABLE 2

Incidence of viable disease organisms*, by locality, in native animals collected from 26 areas in Tooele and Juab Counties, as determined by antibody titers in guinea pigs after parenteral injection of the animal tissues.

Locality	Number tested	Q fever		RMSF		Psitt.		Tul.	
		No.	%	No.	%	No.	%	No.	%
Callao	187	1	0.5	3	1.6	1	0.5	-	-
Camel Back Mountain	88	-	-	-	-	-	-	-	-
CD 22	110	1	0.9	-	-	-	-	-	-
Clover	85	-	-	-	-	-	-	-	-
Dugway Valley	82	1	1.2	1	1.2	-	-	-	-
Easy Area	11	-	-	1	9.1	-	-	-	-
Fish Springs	52	1	1.9	1	1.9	-	-	-	-
Gold Hill	216	-	-	1	0.5	1	0.5	-	-
Government Creek	90	-	-	1	1.1	-	-	-	-
Government Creek, GPI-1***	-	1	-	-	-	-	-	-	-
Granite Mountain	47	-	-	-	-	-	-	-	-
Little Davis Mountain	107	-	-	-	-	-	-	-	-
North Skull Valley	244	-	-	6	2.5	-	-	1**	0.4
Old River Bed	293	-	-	5	1.7	-	-	-	-
Simpson Mountain	12	-	-	-	-	-	-	-	-
South Cedar Mountain	500	2	0.4	9	1.8	2	0.4	-	-
South Skull Valley	15	-	-	2	13.6	-	-	-	-
Test Grids	125	1	0.8	-	-	1	0.8	-	-
Vernon	60	-	-	-	-	-	-	-	-
Wendover	582	4	0.7	-	-	-	-	-	-
Wig Mountain	54	-	-	-	-	-	-	-	-
Wild Cat Mountain	30	-	-	-	-	-	-	-	-
Totals	3,085	12	0.39	30	0.97	5	0.16	1	0.03

* Standard bacteriological tests failed to yield any isolates of B. anthracis, Brucella spp., P. pestis, and only 1 isolate of P. tularensis.

** P. tularensis isolated from tissues of injected guinea pigs and reconfirmed by isolation from original tissues of infected L. californicus.

*** This animal was from Government Creek.

TABLE 3

Incidence of infections as determined by positive antibody titers* in the sera of 20 native animal species in Juab and Tooele Counties. (-) indicates negative results

Species	Number Tested	Q fever		RMSF		Psitt.	
		No.	%	No.	%	No.	%
Lepus californicus	101	10	10.0	9	9.0	4	4.0
Sylvilagus audubonii	6	-	-	-	-	-	-
Citellus leucurus	128	4	3.1	14	10.9	1	0.8
Eutamias minimus	13	-	-	-	-	-	-
E. dorsalis	5	-	-	1	20.0	-	-
Perognathus longimembris	16	1	6.3	2	12.5	-	-
P. parvus	39	1	-	-	-	-	-
P. formosus	39	1	2.6	-	-	-	-
Microdipodops megacephalus	5	-	-	-	-	-	-
Dipodomys ordii	230	14	6.2	17	7.4	7	3.0
D. microps	370	22	6.0	40	10.8	3	0.8
Reithrodontomys megalotis	33	1	3.1	4	12.2	1	3.2
Peromyscus crinitus	23	-	-	-	-	-	-
P. maniculatus	278	6	2.2	20	7.2	2	0.7
P. truei	13	-	-	1	7.7	-	-
Onychomys leucogaster	4	2	50.0	2	50.0	1	25.0
Neotoma lepida	65	2	3.1	2	3.1	5	7.7
N. cinerea	1	-	-	-	-	-	-
Thomomys bottae	1	1	100.0	-	-	-	-
Mus musculus	4	-	-	-	-	-	-
Total	1,364	64	4.68	113	8.28	24	1.76

* Agglutination tests were negative for tularemia and brucellosis

TABLE 4

Incidence of infections as determined by positive antibody titers* in native animal sera from 19 of the areas trapped in Juab and Tooele Counties. (-) indicates negative results.

Locality	Number Tested	Q fever		RMSF		Psitt.	
		No.	%	No.	%	No.	%
Callao	94	4	4.3	9	9.6	3	3.2
Camel Back	68	2	2.9	2	2.9	2	2.9
CD 22	83	4	4.8	6	7.2	2	2.4
Deep Creek	9	-	-	1	11.0	-	-
Dugway Valley	72	8	11.1	19	26.4	3	4.2
Easy Area	4	1	25.0	-	-	-	-
Fish Springs	46	2	4.3	1	2.2	-	-
Gold Hill	132	4	3.0	11	8.3	1	0.8
Government Creek	3	-	-	-	-	-	-
GPI-1	7	-	-	-	-	-	-
Granite Mountain	21	-	-	-	-	-	-
Little Davis Mountain	49	3	6.1	4	8.1	3	6.1
North Skull Valley	88	8	9.1	6	6.8	2	2.3
Old River Bed	24	2	8.3	4	16.7	-	-
South Cedar Mountain	148	4	2.7	17	11.5	5	3.4
Test Grids	98	2	2.0	2	2.0	1	1.0
Trout Creek	12	1	8.3	1	8.3	1	8.3
Wendover	395	17	4.3	28	7.1	-	-
Wig Mountain	11	1	9.1	1	9.1	-	-
Total	1,364	64	4.68	113	8.28	24	1.76

* Agglutination tests were negative for brucellosis and tularemia.

TABLE 5

Frequency of Rocky Mountain spotted fever organisms in ectoparasite pools from native animals collected in Juab and Tooele Counties. Shown as the number of positive/number of pools tested. Complement fixation titers of 1/16 or greater in either of a pair of injected guinea pigs was considered positive.

Locality	Fleas	Ticks	Mites	Lice
Callao	0/2	0/1	0/1	0/3
Camel Back Mountain	0/4	0/3	0/1	-
CD 22	0/3	1/2	0/2	0/2
Clover	0/3	1/2	0/1	0/1
Dugway Valley	1/3	1/4	0/1	1/3
Fish Springs	1/1	0/2	0/1	0/1
Gold Hill	1/4	0/10	0/1	1/4
Government Creek	0/8	0/3	0/1	0/2
Granite Mountain	0/1	0/2	0/1	0/1
Little Davis Mountain	0/1	0/3	0/2	1/2
North Skull Valley	0/2	2/2	0/1	0/1
Old River Bed	3/10	1/3	1/2	0/1
Simpson Mountain	-	0/1	-	-
South Cedar Mountain	0/20	4/17	0/5	3/10
South Skull Valley	-	0/1	-	-
Test Grids	0/2	0/3	0/1	1/2
Vernon	0/2	1/2	1/3	0/2
Wendover	0/5	0/4	0/2	2/6
Wig Mountain	0/2	3/5	-	-
Wild Cat Mountain	-	0/1	-	-
Total	6/73	14/71	2/26	9/41

TABLE 6

Incidence of infections as determined by positive antibody titers in domestic cattle sera from selected areas in the study

Species	Number tested	Number of Positive Titers				
		Q fever	RMSF	Psitt.	Tul.	Bruc.
Cattle	176	-	3	-	-	-
Total	176	-	3	-	-	-